

Biofiltration of Toxic Metals from Acid Mine Drainage

"Mikro-Tek has developed a natural and highly cost-effective biofiltration system to accelerate the regeneration of mine waste sites. Documented field trial results demonstrate that, over the long term, this system may substantially reduce acid mine drainage. Matching specifically adapted microbes to a native, nitrogen-fixing tree species and pre-inoculating the seedlings before planting ensures improved survival on harsh, nutrient-poor mine site conditions. We now want to expand our microbe collection to include specific targeted species from other areas across Canada and internationally, and to actively market this biofiltration and revegetation technology to mine reclamation projects in these areas."

Mark Kean
President, Mikro-Tek Labs
Timmins, Ontario

THE COMPANY

Mikro-Tek conducts research and development in the field of microbial biotechnology. Its focus is on naturally-occurring micro-organisms that enhance plant survival and growth rates. The company has facilities and equipment to produce commercial quantities of microsymbionts (*Frankia*, mycorrhizae, rhizobia). A climate-controlled growth room is used to test the microbes' performance on various host plants for specific user needs. Mikro-Tek also offers a range of field and test services to support implementation of its technology.

THE CHALLENGE

Various methods have been successfully undertaken to reduce water and oxygen contact with reactive mine waste material. Submerging the material under water to stop contact is practical only where a natural depression or lake allows for economic disposal and flooding. Also promising is



FOREGROUND — Forest cover of three-year-old, microbially inoculated pine and alder trees on acid tailings. MIDDLE GROUND — Preparation of tailings material using organic supplement prior to planting. BACKGROUND — Acid-generating mine tailings yet to be revegetated.

passing the mine effluent as an integrated biological solution through naturally-occurring or engineered wetlands. Man-made material covers (plastic, asphalt, cement, etc.) have high installation costs and questionable long-term stability.

A self-sustaining soil and forestry cover could provide a permanent, walk-away cap over the mine waste material. This would result in less oxygen and water reacting with the waste material, and reduce long-term treatment costs.

TECHNOLOGY DESCRIPTION

Actinorhizal plants (e.g. alder species), established in a soil cover over tailings or waste rock areas, can be instrumental in long-term control of acid mine drainage. As a primary biofilter, alders intercept precipitation by means of evapo-transpiration before it can react with the tailings to become acid mine drainage.

The soil cover can be engineered taking into consideration specific factors, such as materials available and

geographic conditions at the site. Annual precipitation and the water-holding capacity of the soil material would determine the thickness of the cover. The chosen symbiotic micro-organisms would enhance tree seedling survival and growth, and ensure rapid establishment under harsh, nutrient poor conditions.

RESULTS

The project demonstrates that various tree species, particularly the pioneering alder, can survive and grow at acceptable rates when pre-inoculated with naturally-adapted, symbiotic micro-organisms and directly planted on mine tailings material. However, the organic biomass soil building process might not be fast enough to achieve the immediate effects required to reduce water infiltration.

To speed up plant establishment, Mikro-Tek proposes to engineer a soil cover by introducing organics, soil micro-organisms and trees. A healthy forest established on a clay/topsoil cover could reduce infiltration of water

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through tailings material from 50 - 80 per cent as tree seedlings mature. This would lower perpetual treatment and maintenance costs.

Each specific mine site would be a unique situation, taking into account its geographic location, tailings material, local plant species, availability and type of soil, and organic matter. Possible sources for organics could be peat moss, biosolids from pulp mills, waste sawdust/bark from local sawmills, or on-site biomass production by a grass/legume cover.

A preliminary investigation into the use of paper mill biosolids shows that tree growth and survival is greatly increased in specific mixtures of biosolids with acidic tailings. Additional potting and field tests on various mine sites are in progress.

TECHNOLOGY OPPORTUNITIES

Mikro-Tek is currently expanding its microbial culture bank to include species of interest from the various geographic mining areas across Canada and the United States. Additional markets include forest vegetation caps to close out municipal landfill sites and the reclamation of sand and gravel pits. The technologies can also be adapted to tropical tree species and their corresponding soil micro-organisms, enabling Mikro-Tek to address the reclamation needs of large mines in other countries.

During the demonstration phase of this project, Dome Mines and the Ministry of Northern Development and

Mines (Kam-Kotia site) supplied suitable areas for field plot establishment and testing.

Commercialization of the technology is under way and the company is working on field projects at mine sites with Billiton (Les Mines Selbaie), INCO, Dome, Kidd Creek, Ontario Ministry of Northern Development and Mines (Kam-Kotia, Hollinger and Matachewan sites), as well as various exploration test sites with the Yukon Mineral Resource Branch.

PARTNERSHIP IN POLLUTION PREVENTION AND RESOURCE CONSERVATION

The demonstration of this technology was partially supported by the Ontario Ministry of the Environment.

Industrial companies located in Ontario may seek ministry / industry services that will help them to:

- * reduce, reuse and recycle solid waste;
- * effectively remediate historic pollution and destroy hazardous contaminants;
- * reduce or eliminate liquid effluent and gaseous emissions;
- * use energy and water more efficiently.

Equipment and services supply companies can benefit from the information provided on technologies identified for business development.

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